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(71) Applicants
The Kendall Company, 1 Federal Street, Boston, Massachusetts 02101, United States of America
(72) Inventor
Carlos Miguel Samour
(74) Agents
Gee and Co., Chancery House, Chancery Lane, London WC2A 1QU

(54) Method of coating pipes

(57) Steel pipe 20 is coated by coextruding a composite heat softenable sheet 18, comprising a lower layer 14 of thermoplastic adhesive and an upper layer 18 of protective thermoplastic onto the surface of the pipe 20 as it is simultaneously rotated and advanced axially to form thereon a helical wrap having an overlapping or a butt seam. A heat-shrinkable tape 22 may be applied over the helical seam. The composite sheet 18 can be applied to the steel surface with or without first priming and/or heating the pipe 20.

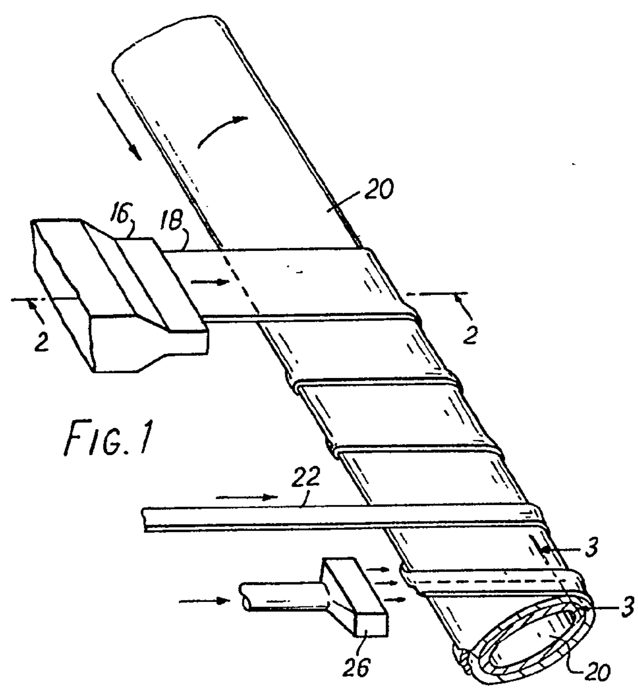

FIG. 1

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FIG. 4

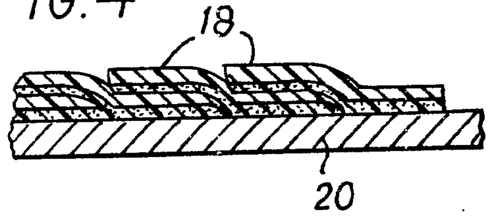
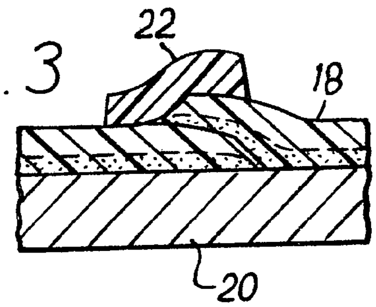


FIG. 3



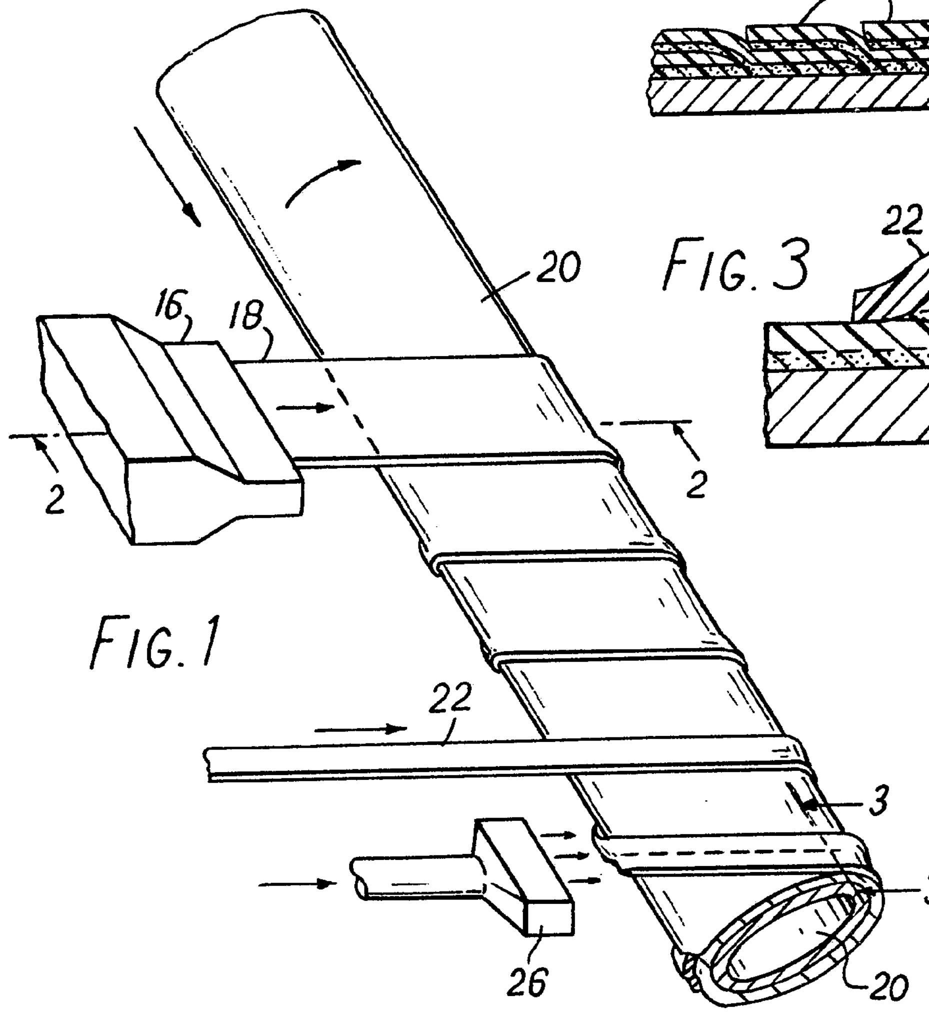


FIG. 1

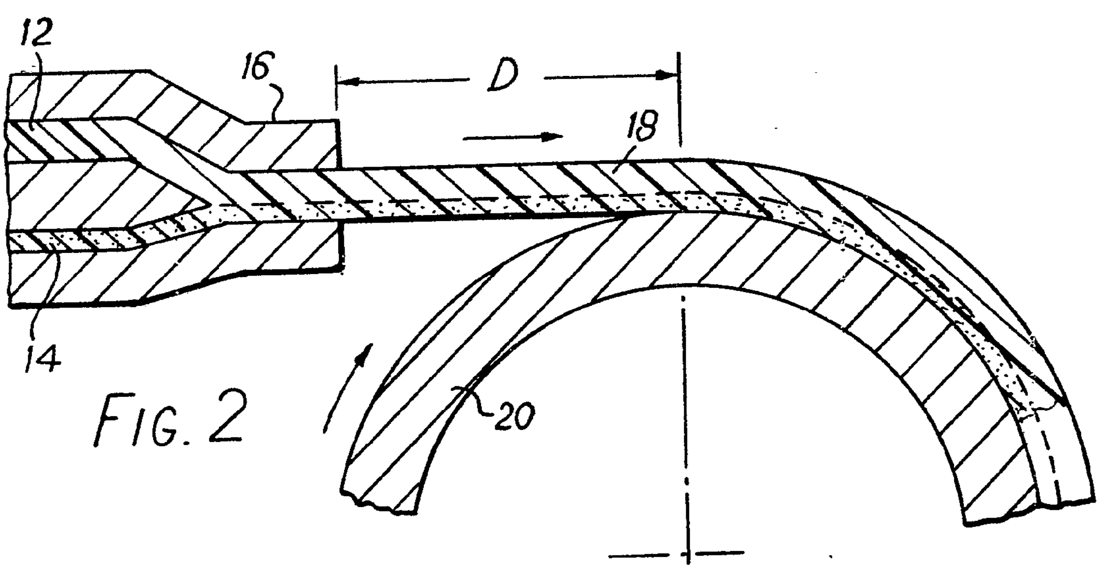


FIG. 2

SPECIFICATION

Method of coating pipes

This invention relates to a method of coating pipes particularly large diameter metal or steel pipes with protective thermoplastic sheet or film to provide protection against metallic corrosion and pertains more specifically to such coatings of the helical wrap type.

It has previously been proposed to apply protective thermoplastic sheet coatings to metal pipe by first extruding a band of heat softened thermoplastic adhesive and wrapping it helically about a pipe, either heated or unheated, followed by extruding a second band of protective thermoplastic material and helically wrapping it with an overlap in one or more layers over the adhesive coating, as described in U.S. Patents Landgraf 3,616,006, Emmons 3,802,908 and Hielema 3,823,045. These processes have suffered from disadvantages in that the adhesive layer and the thermoplastic layer do not in general provide optimum bonding to each other and in requiring that the operation and speed of extrusion of two separate extruders be synchronized with each other. Furthermore, when the band of protective thermoplastic is applied with an overlap, or when more than a single layer of protective thermoplastic is applied, as proposed in the prior art, the lack of any adhesive at the interfaces between opposing margins or faces of the protective thermoplastic frequently results in inadequate bonding and is thereby more likely to lead to failure of the coating.

The process of the present invention overcomes these difficulties by ensuring that the non-adhesive protective thermoplastic always is bonded by an adhesive layer to whatever underlying surface the protective thermoplastic is to be applied over, whether it be a metal pipe surface or the surface of a protective thermoplastic wrap previously applied to the pipe. The process further makes possible the use of a thermoplastic adhesive and in particular makes possible the use of such an adhesive having a lower viscosity at the time it contacts the pipe surface than do the methods of the prior art. The greater fluidity of the adhesive provides improved wetting of the metal surface and better adhesion. Moreover, in the process of the present invention an improved bond is obtained between the several layers of the composite sheet because of the highly fluid nature of both layers at the time they are combined by coextrusion. The process eliminates the need for synchronizing the operation and speed of extrusion of two separate sheets and provides greater freedom of choice both in the number of layers which can be applied to the pipe and in their composition.

According to the present invention there is provided a method of coating pipe which comprises coextruding through an orifice a composite sheet having at one surface at least one layer comprising heat softened thermoplastic adhesive and at the other surface at least one layer comprising a heat softened non-adhesive protective thermoplastic, said heat softened non-adhesive protective thermoplastic layer being less fluid than said heat softened thermoplastic adhesive layer and being no less than half the total thickness of said composite sheet, said layers being coextensive in area, applying the adhesive surface of said heat softened composite sheet to the surface of said pipe spaced from said orifice while simultaneously rotating said pipe about its axis and advancing said pipe along its axis to wrap said composite sheet helically about said pipe, said sheet being unsupported between said orifice and said pipe surface, controlling both the rate of coextrusion and the rate of rotation and advance of said pipe to maintain the tension on said composite sheet before contact of the composite sheet with the pipe surface at a value less than that which produces substantial change in the cross-sectional dimensions of said unsupported heat softened sheet, and cooling said composite sheet on the surface of said pipe to form a coating having a thermoplastic protective outer surface adhesively bonded to said pipe surface. By coextruding (coextrusion) is meant the well-known process of simultaneous extrusion of two or more different thermoplastics into a multilayered composite sheet as described for example in TAPPI Monograph Report No. CA-43, Chapter 6 (1973). Coextrusion provides improved bonding of the several layers because of the high fluidity of the layers at the time of formation of the composite sheet. This eliminates the need for conventional chemical or adhesive priming of the pipe or of the layers. The composite sheet is formed either immediately before or immediately after (within a fraction of an inch) coextrusion from the die orifice.

Some embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a partially schematic isometric view showing one embodiment of the present invention;

Fig. 2 is a view in section taken along lines 2—2 of Fig. 1;

Fig. 3 is a view in section taken along lines 3—3 of Fig. 1; and,

Fig. 4 is a view in section showing another embodiment having a fifty percent overlap.

As shown in Figs. 1 to 3, one embodiment of the method of the present invention is carried out by supplying from separate extruder barrels (not shown) a stream of heat softened protective thermoplastic 12, a second stream of heat softened thermoplastic adhesive 14, and coextruding the streams through a single die orifice 16 to form a composite sheet 18 having at its top surface a layer of heat softened protective thermoplastic and at its bottom surface, a layer of heat softened thermoplastic adhesive. The two layers of the composite sheet, as they emerge from the die orifice 16, are in close and intimate contact throughout the extent of their opposing

surfaces, and consequently remain firmly bonded to each other even though the materials of the two layers when applied separately provide a bond of inferior strength. In the case of a very fluid hot melt adhesive layer on a less fluid protective thermoplastic layer, it may be desirable to apply the sheet to the bottom of the rotating pipe rather than to the top, in which case the adhesive layer is uppermost.

Pipe 20 need not be heated but should be clean and dry for best results. If the pipe is stored outdoors, as is conventional, especially in the case of large diameter pipe, it may be covered with rain, dew, or frost which should be removed. The removal is most conveniently accomplished by heating the pipe to vaporize the material and such heating has no deleterious effect upon the coating. Excessively high temperatures of the pipe are undesirable because they delay the setting of the coating and render the coating vulnerable to displacement until setting is complete, and excessively low temperatures are also undesirable since they prevent the adhesive layer from developing optimum bonding to the pipe. The pipe temperature desired in any particular case varies to a great extent depending upon the nature of the adhesive layer and the temperature at which it is extruded, ranging from below room temperature to temperatures substantially above room temperature. Preferred pipe temperatures are below 100°C but at or above ambient temperature.

Pipe 20, after cleaning and drying if necessary, is simultaneously rotated about its axis in the direction shown by the arrow and advanced along its axis past extrusion die orifice 16 while the bottom heat softened adhesive surface of the composite sheet 18 is applied to the pipe surface to wrap the composite sheet helically about the pipe. It is essential for best results that the rate of extrusion and the rate of rotation and advance of the pipe be adjusted to each other so that the tension on the composite sheet between the coextrusion die orifice and the contact of the sheet with the pipe surface, designated by the letter D in Fig. 2, is maintained at a value less than that which produces substantial necking down of the heat softened composite sheet, i.e., substantial change in the cross-sectional dimensions thereof between its coextrusion and its point of contact with the pipe. Preferably the tension is such that it produces no more than 5% elongation of the heat softened sheet.

The thermoplastic adhesive may be any of those compositions conventionally employed for adhesion to metal surfaces such as steel and may be a single material or a mixture of two or more different materials; among suitable materials are an ethylene-vinyl acetate copolymer, an ethylene-ethyl acrylate copolymer, and natural and synthetic rubber compositions tackified with appropriate tackifying agents. The protective thermoplastic layer may be any conventional tough and tear resistant material which is heat softenable and extrudable in the same range of temperatures as the thermoplastic adhesive; polyolefins such as polyethylene and polypropylene are preferred, but polyvinyl chloride, acrylonitrile-butadiene-styrene interpolymers, polymers and copolymers of vinylidene fluoride, polymers and copolymers of chlorotrifluoroethylene, and polyolefin ionomers such as copolymers of ethylene with acrylic acid partly neutralized with sodium zinc or magnesium can also be used.

As shown in Figs. 1 and 3, the composite sheet is preferably applied to form an overlapping seam between adjacent turns of the helical coating on the surface of the pipe; it is possible, if desired, to form thicker coatings by overlapping adjacent turns up to any extent desired on the pipe or to form a non-overlapping butt seam. By careful control of the tension on the composite sheet in the zone marked D in Fig. 2 to maintain control of the extent of stretching or elongation of the heat softened sheet, both the thickness or gauge of the sheet and its width are controlled, ensuring a close fit along the length of the seam as well as ensuring a coating having uniform thickness and strength throughout the non-overlapped area, free from thin spots and non-adhered areas. The thickness or gauge of the composite sheet 18 can be varied at will from about 7 mils to about 120 mils of which the thickness of the thermoplastic adhesive layer may vary from 2 to 25 mils and the thickness of the protective thermoplastic layer from 5 to 118 mils. The thickness of the adhesive layer is no more than half the total thickness of the composite sheet, usually from 5 to 30% of the total thickness, depending on the total thickness of the composite sheet which in turn varies depending on pipe diameter and the extent of impact resistance desired.

In the preferred embodiment shown in Fig. 4, the overlap is 50% to provide a coating having twice the thickness of composite sheet 18. By employing a greater extent of overlap, even greater total thicknesses of coating can be applied.

Since pipe 20 need not be heated and normally is at or slightly above room temperature or ambient temperature at the time the heat softened sheet is applied, the sheet cools fairly rapidly as soon as it comes into contact with the surface of the pipe to form a coating having a thermoplastic protective outer surface adhesively bonded to the pipe surface. It may also be desirable to provide cooling as by a stream of cold air, at or after the point of application to the pipe so that the pipe can be handled without damage immediately after the coating is complete.

In order to ensure sealing of the seam, it is also possible as an optional feature to apply over the helical seam, either lapped seam or butt seam, as an additional step a ribbon or tape 22 comprising a heat shrinkable thermoplastic material such as oriented polyethylene, polyvinyl chloride, polypropylene containing rubber such as ethylene-propylene rubber or the like. A heat source 26

such as an infrared heater or a flame is provided to heat the tape after it has been applied to cause it to shrink about the coated pipe along the seam. The coated pipe may be cooled to room temperature before or after applying and shrinking tape 22 in place. Ribbon or tape 22 may also be a molten extrusion of the same composition as the outer coating layer 12, in which case heat source 26 can be omitted.

CLAIMS

1. A method of coating pipe which comprises coextruding through an orifice a composite sheet having at one surface at least one layer comprising heat softened thermoplastic adhesive and at the other surface at least one layer comprising a heat softened non-adhesive protective thermoplastic, said heat softened non-adhesive protective thermoplastic layer being less fluid than said heat softened thermoplastic adhesive layer and being no less than half the total thickness of said composite sheet, said layers being coextensive in area, applying the adhesive surface of said heat softened composite sheet to the surface of said pipe spaced from said orifice while simultaneously rotating said pipe about its axis and advancing said pipe along its axis to wrap said composite sheet helically about said pipe, said sheet being unsupported between said orifice and said pipe surface, controlling both the rate of coextrusion and the rate of rotation and advance of said pipe to maintain the tension on said composite sheet before contact of the composite sheet with the pipe surface at a value less than that which produces substantial change in the cross-sectional dimensions of said unsupported heat softened sheet, and cooling said composite sheet on the surface of said pipe to form a coating having a thermoplastic protective outer surface adhesively bonded to said pipe surface.

2. A method as claimed in Claim 1, wherein said composite sheet is applied to form a helical overlapping seam between adjacent turns of the helical coating on said pipe.

3. A method as claimed in Claim 1, wherein said composite sheet is applied to form a helical butt seam between adjacent turns of the helical coating on said pipe.

4. A method as claimed in Claim 2 or 3 and including the additional steps of applying over the helical seam a ribbon of heat-shrinkable thermoplastic and subsequently heating the ribbon to cause said ribbon to shrink about said coated pipe along said seam.

5. A method as claimed in any preceding claim, wherein said heat-softened thermoplastic adhesive layer has a thickness of from 5 to 30% of the total thickness of said composite sheet.

6. A method as claimed in Claim 1 and substantially as herein described.

7. A method of coating pipe, substantially as herein described with reference to Figs. 1 to 3 or Figs. 1, 2 and 4 of the accompanying drawings.

8. A pipe when coated by a method as claimed in any preceding claim.

9. The features as herein disclosed, or their equivalents, in any novel selection.

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